Field Demonstration of a Membrane Process to Recover Heavy Hydrocarbons and to Remove Water from Natural Gas

Annual Report

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by

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Disclaimer

Abstract

The objective of this project is to design, construct and field demonstrate a membrane system to recover natural gas liquids (NGL) and remove water from raw natural gas. An extended field test to demonstrate system performance under real-world conditions would convince industry users of the efficiency and reliability of the process. The system has been designed and fabricated by Membrane Technology and Research, Inc. (MTR) and will be installed and operated at British Petroleum (BP)-Amoco's Pascagoula, MS plant. The Gas Research Institute will partially support the field demonstration and BP-Amoco will help install the unit and provide onsite operators and utilities. The gas processed by the membrane system will meet pipeline specifications for dewpoint and BTU value and can be delivered without further treatment to the pipeline. Based on data from prior membrane module tests, the process is likely to be significantly less expensive than glycol dehydration followed by propane refrigeration, the principal competitive technology. At the end of this demonstration project the process will be ready for commercialization. The route to commercialization will be developed during this project and may involve collaboration with other companies already servicing the natural gas processing industry.

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1. INTRODUCTION

The objective of this project is to design, construct and field demonstrate a membrane system to recover natural gas liquids (NGL) and remove water from raw natural gas. An extended field test to demonstrate system performance under real-world conditions would convince industry users of the efficiency and reliability of the process. The system has been designed and fabricated by Membrane Technology and Research, Inc. (MTR) and will be installed and operated at British Petroleum (BP) Amoco's Pascagoula, MS plant. The Gas Research Institute (GTI) will partially support the field demonstration and BP-Amoco will help install the unit and provide onsite operators and utilities. The gas processed by the membrane system will meet pipeline specifications for dewpoint and BTU value and can be delivered without further treatment to the pipeline. Based on data from prior membrane module tests, the process is likely to be significantly less expensive than glycol dehydration followed by propane refrigeration, the principal competitive technology. At the end of this demonstration project the process will be ready for commercialization. The route to commercialization will be developed during this project and may involve collaboration with other companies already servicing the natural gas processing industry.

2. PROGRESS FROM SEPTEMBER 30, 2003-SEPTEMBER 29, 2004

The work accomplished during the period September 30, 2003 through September 29, 2004 is summarized by task below.

The MTR membrane system was installed at the BP Amoco Pascagoula gas processing plant during 2004. The plant was undergoing a very significant expansion in capacity and the installation of the membrane unit did not begin until late in the third quarter of 2004. The system startup and initial testing will occur in the February 2005 timeframe. A photo of the MTR membrane unit at Pascagoula is provided in Figure 1.

Summarizing our 2004 commercialization efforts, significant progress was made toward introducing MTR's NGL membrane and systems into the natural gas market.

Figure 1. MTR's field demonstration membrane-based gas treating unit at BP Amoco's Pascagoula, MS gas processing plant. The membrane unit was installed in late 2004; start-up and testing is scheduled to begin in February 2005.

Task 4.0 Develop Field Test Plan

Based on the total available budget in late 2004, we anticipate a 2- to 4-month testing period. This may be extended if the BP Amoco plant provides support in the day-to-day operating expenses which would allow MTR to run the performance demonstration for a longer time.

The field test plan as envisioned at this time is summarized in Table 1.

Table 1. Test Plan for NGL Field Demonstration

Month	Testing Protocol	MTR Personnel Involvement	Site Personnel Involvement
1	Startup/solving teething issues in the unit. Initial testing at available plant conditions	Yes (1 week). Daily data collection and analysis of all key streams	Daily data collection including pressure, temperature and flow rate; weekly data collection for gas composition of key streams.
2	Parametric testing of variation in pressure and flow rate	Yes (1 week). Pressure variation: 500 – 1000 psia Flowrate variation: 1-3 MMSCFD	Daily data collection including pressure, temperature and flow rate; weekly data collection for gas composition of key streams.
3	Continuous operation at available plant conditions	No	Daily data collection including pressure, temperature and flow rate; weekly data collection for gas composition of key streams.
4	Continuous operation at available plant conditions	Yes (1 week). Daily data collection and analysis of all key streams	Daily data collection including pressure, temperature and flow rate; weekly data collection for gas composition of key streams.
5	Continuous operation at available plant conditions	No	Daily data collection including pressure, temperature and flow rate; weekly data collection for gas composition of key streams
6	Parametric testing of variation in pressure and flow rate	Yes (1 week). Pressure variation: 500 – 1000 psia Flowrate variation: 1-3 MMSCFD	Daily data collection including pressure, temperature and flow rate; weekly data collection for gas composition of key streams

The above table gives a broad outline of the activities planned for the time during which the system will be operated at the Pascagoula facility, with the last two months depending on the level of support received from BP Amoco. Our previous experience in performing such field demonstrations has shown that variation of various key parameters over a wide range is typically not possible due to the potential disruption in operations that would result at the client facility. Therefore, the above estimates of the variations in pressure and flowrates that we would test in months 2 and 6 are based on our initial assessments and will have to be confirmed with on site personnel.

Task 5.1 Prepare Membranes and Modules

This task was completed in 2003.

Task 5.2 Design and Construct Field Demonstration System

This task was completed in 2003. Some field modifications had to be made in 2004 in order to comply with the plant specifications, which were provided to us once the unit was in place at the BP Amoco facility.

Task 5.3 Install Systems at Site/Initial Evaluation

The installation of the membrane unit and the compressor finally commenced in the third quarter of 2004. The system was hooked into the plant lines and all required electrical cable runs, motor start-ups, PLC, and related activities were completed by the end of 2004.

Task 5.4 Operate System Continuously

The system will be commissioned in February 2005. Once all the initial bugs are worked out, we expect to run the system continuously to obtain data per the test plan. We expect the testing to last 2-4 months.

Task 5.5 Survey Industry Users/Analyze Economics

As mentioned in our previous reports, we have identified the following three applications relevant to this project as focus areas in terms of commercialization of the technology.

- Fuel gas conditioning (gas engines and turbines)
- NGL recovery from rich associated gas streams (upto 15 MMSCFD)
- Gas processing for dewpoint control (up to 20 MMSCFD)

We have continued to pursue the development of these applications and have acquired significant insights in both the technical and marketing areas. Based on this knowledge, MTR and ABB (our commercialization partner in this product area) have developed various strategies and tactics to address what we have learned are key requirements of the customers. In particular, we have

- Developed a standardized layout and membrane skid to lower repetitive engineering costs and to develop essentially reusable systems.
- Developed a detailed package of system specifications to allow rapid transfer of information to potential clients.
- Built a network of fabrication shops and contacts to minimize building costs and accelerate delivery schedules.

Completing all of these tasks has allowed the MTR-ABB alliance to quickly come up with skid pricing and also to generate proposal documents for potential clients in a rapid manner.

Task 5.6 Develop Commercialization Plan

In pursuing the commercialization of the technology, we determined that several key issues had to be tackled in order to be successful in pushing the technology into general use in the natural gas market. These include:

1. Access to markets and consistent collection of valid qualified leads and prospects related to the focus applications

Developing access to the market has been attempted through several initiatives. MTR formed a marketing alliance with ABB Lummus Global – Randall Gas Technologies in 2002. Our commercialization efforts with ABB are described in more detail in Task 5.5 above.

We have also attempted to set up alliances with industry-specific suppliers; for example, gas engine manufacturers such as Caterpillar and Waukesha. Since their engines would require the use of MTR membranes for gas conditioning, it was expected that they would be receptive to our overtures. We have, however, discovered that gas engine manufacturers do not want to add anything to their scope of supply for the fear of having a higher overall initial price, which in their opinion may cause them to lose the initial bid. They have informed us that they will let the final client know that to use the gas engines, the gas has to meet a certain specification, but that it is the final client's responsibility to determine how such a specification can be met.

Due to this reluctance on the part of the gas engine manufacturers to accept and incorporate membrane-based gas conditioning systems, we have had to change our strategy. We are currently marketing directly to the end users as our clients. Specifically, we are trying to locate those clients that are having problems with their gas engines due to fuel gas conditioning problems. By locating such potential clients and showcasing our product as a problem-solving tool, we expect to be able to convince clients to buy the membrane system to alleviate their problems. We have already seen some success in this approach and continue to expand the reach to such clients by various means.

2. Ability to provide a technically adequate solution for the problem

In the case of fuel gas conditioning, we have determined that our solution works best for applications in remote locations, such as close to the wellhead or on offshore and floating (FPSO) platforms. At such locations, good quality gas is not available and the client has to use the only gas available at the site, which is typically low grade. With this technical and market knowledge, we are able to focus our commercialization effort into the most productive areas.

3. Ability to inspire confidence in the customer and an adequate comfort level with the new technology

As we have installed a few units, we are seeing more and more receptiveness in our clients to use the membrane process as a solution.

4. Ability to correctly price the systems to meet customer expectations and expected competition

We continue to work on this aspect of our marketing and business approach in order to deliver solutions that are commercially acceptable to clients. Our current understanding is that for retrofit installations in which we are fixing an existing problem, the pricing flexibility is significantly greater than for new installations in which the client is trying to ward off a potential future fuel problem.

5. Ability to deliver a system in the shortest possible elapsed time from placement of order

This has been consistently noted as an important factor in all our commercialization efforts. Typical delivery times are 12-14 weeks from placement of order. In order to address elapsed time issues, we are upgrading our membrane and module manufacturing and also devising better engineering approaches that minimize the delivery schedule and meet client expectations.

6. Ability to predict and control costs to ensure profitability

We have standardized our costing datasheets, and now have gained a much higher level of experience in costing the system from our proposal preparation and sales efforts. We are getting more and more comfortable in predicting the cost of systems to ensure consistent and predictable profitability on projects.

7. Ability to provide final client with innovative financing methods, including leases and processing fees.

This is an aspect we are working on with our partners at ABB. The current consensus is that we need to have several operating systems in the field, each operating efficiently under design conditions, before we consider innovative financing arrangements for clients.

During 2004, we delivered a fuel gas conditioning unit to Dominion Resources, Canada. This FGCU is capable of processing about 2 MMSCFD and is not only reducing heavy hydrocarbons but also reducing hydrogen sulfide (H_2S) levels in fuel gas for a set of gas engines. The system was commissioned in early second quarter 2004 and has been consistently performing at better than guaranteed conditions since then. The end-client has expressed satisfaction at the operation of the unit. Based on the success of this installation we have been approached by several parties that are interested in acting on behalf of MTR to sell systems in Canada for similar applications.

Also during 2004, two additional fuel gas conditioning systems were sold, the first to Star Energy (Gulf Resources) for an offshore platform in Indonesia processing about 1.5 MMSCFD of fuel gas and the second to Plains Exploration, Bakersfield, CA. Cumulative sales for these two systems was about US$340,000. Both system have been fabricated and delivered to the clients and are currently under installation.

MTR's marketing efforts have been focused on the best possible utilization of our website www.mtrinc.com. The website approach has produced the most consistent results in generating high quality leads and inquiries for sales of fuel gas conditioning units. All systems sales related to this project have been developed as a result of our website marketing efforts. We continue to generate between 12 and 15 inquiries every week from our website.

Task 6.0 Final Report/Conference Presentation

ABB/MTR made two conference presentations in 2004, the first one at the prestigious Laurance Reid Gas Conditioning conference in Oklahoma and the second at the Annual GPA conference in New Orleans.

3. CONCLUSION

There are two parts to this demonstration project. The first part involved building, installing, and testing a demonstration plant for NGL separation and recovery and the second part involved commercialization activities. While the first part of the project has seen many unavoidable delays due to the various requirements and delays at the host site, this portion is now reaching the stage that the first tests will start in early 2005. We expect to run the unit for at least a few months to accumulate high-pressure separation data.

The second portion of the project, the commercialization of the technology, has progressed very well. We have sold and installed several commercial units using the membrane technology developed in this project and these installations have been operating satisfactorily for their clients. We attribute part of this success to our efforts at firming up our processes and procedures for commercialization of the technology and implementing them. In particular, our website marketing strategy is yielding very good results in leads generation. During 2004, one system was purchased online and two additional systems were sold. We expect to continue to sell more fuel gas conditioning units in 2005 and to see the momentum of these activities build up as more and more units are installed, resulting in greater customer confidence.

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